DECLARATION

I, TAKAO MATSUI, a Japanese Patent Attorney registered No. 12006, of Okabe International Patent Office at No. 602, Fuji Bldg., 2-3, Marunouchi 3-chome, Chiyoda-ku, Tokyo, Japan, hereby declare that I have a thorough knowledge of Japanese and English languages, and that the attached pages contain a correct translation into English of the priority documents of Japanese Patent Application No. 10-208536 filed on July 9, 1998 in the name of CANON KABUSHIKI KAISHA.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 21st day of August, 2006

Takao Matsui

TAKAO MATSUI

10-208536

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[Title of the Invention] Power Control Apparatus, USB equipment And Power Control Method

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[Material]	Drawings	1
[Material]	Abstract	1
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JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this office.

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Commissioner,
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[Name of the Document] Specification

[Title of the Invention] Power Control Apparatus, USB equipment And Power Control Method

[What is Claimed is]

[Claim 1]

A power control apparatus for a driving device to which power is supplied from a power supplying device which is subject to current limitation at a predetermined current limit value, wherein said power control apparatus comprising:

a chargeable battery; and

a charge control part for charging said battery while a current drain is lower than said limit current value,

wherein when the current drain exceeds said limit current value, a current is supplied from said battery to said driving device.

[Claim 2]

A power control apparatus according to Claim 1, wherein said driving device is a device a current drain of which becomes transiently over said limit current value.

[Claim 3]

A power control apparatus according to Claim 1 or 2, wherein the power from said power supplying device is supplied via a USB connector.

[Claim 4]

A USB equipment comprising a driving device to which

power is supplied from a power supplying device which is subject to current limitation at a predetermined current limit value, and a power control device connected to said power supplying device via a USB connector and arranged to control supply of the power to said driving device,

wherein said power control device comprises a rechargeable battery, and a charge control part for charging said battery while a current drain is lower than said limit current value, and wherein when the current drain exceeds said current limit value, a current is supplied from said battery to said driving device.

[Claim 5]

A USB equipment according to Claim 4, wherein said driving device is a device a current drain of which becomes transiently over said limit current value.

[Claim 6]

A USB equipment according to Claim 5, wherein said driving device is comprised of a speaker device incorporating a power amplifier.

[Claim 7]

A USB equipment according to Claim 5, wherein said driving device is comprised of a floppy disk drive.

[Claim 8]

A power control method for a driving device to which power is supplied from a power supplying device which is subject to current limitation at a predetermined current limit value, said power control method comprising steps

of:

preparing a rechargeable battery;

charging said battery while a current drain is lower than said current limit value; and

supplying a current from said battery to said driving device when the current drain exceeds said limit current value.

[Claim 9]

A power control method according to Claim 8, wherein said driving device is a device a current drain of which becomes transiently over said limit current value.

[Detailed Description of the Invention]

[0001]

[Field of the Industrial Utilization]

The present invention relates to a power control apparatus, a power control method for a driving apparatus such as a speaker device incorporating a power amplifier or a floppy disk drive and a USB equipment provided with such a power control apparatus.

[0002]

[Prior Art]

At present, Universal Serial Bus (USB) and IEEE1394 are drawing attention as interface buses for personal computers. These interfaces incorporate a power line, taking easiness and convenience of connection thereof into account.

[0003]

However, supplied power also has to be limited with consideration to the load on the power supply of the host device and USB has the current limitation of 5 V and max 500 mA according to the standard thereof. In the USB host device, i.e., on the power supply side, when the load current of USB devices under connection exceeds the aforementioned current limit value, a protection circuit is activated to interrupt the power supply to the USB devices.

[0004]

[Problems to be Solved by the Invention]

The conventional USB devices, however, have the following problem.

[0005]

Among potential devices as USB devices, there are devices necessitating a large current drain in a short and transient period, though an average power consumption of such devices is low. For example, it occurs upon activation of a motor in a disk device such as a floppy disk drive, during a large sound output in a loudspeaker system incorporating an amplifier, and so on.

[0006]

Although this transient power is of the short period of time, it is not practical to cover it by a capacitor or the like, because the necessary capacitance thereof is too large. In such cases, therefore, a conceivable countermeasure heretofore was either one of a method of designing the device so as to be active within the range

of power supply capability at the expense of performance of the device and a method of giving a higher priority to the performance of the device. However, when the higher priority was given to the performance of the device, the power supply to the device had to be supplied from an outside power other than the USB interface bus and this posed the problem of degrading convenience and simplicity of USB.
[0007]

For example, when a stereo speaker system using the USB interface is intended to design, the maximum power that can be achieved by the power supply of 5 V and 500 mA (250 mA per a channel) is only 625 mW per a channel even with no loss. Further, in order to gain the maximum output in an Output Transformer Less (OTL) state, the impedance of the speakers is limited to 20 Ω, which is not a normally practical value, unless a DC-DC converter or the like is used. The maximum power is 3.13 W under the conditions of the power-supply voltage 5V, the impedance 4 Ω of the ordinary speakers, and OTL.
[0008]

In view of the aforementioned problems in the conventional technology, an object of the present invention is to provide a power control apparatus and a power supply control method of USB equipment that can assure the convenience and simplicity of USB without degrading the performance of USB equipment, and also provide a USB equipment equipped with this power control apparatus.

[0009]

[Means for Solving the Problems]

In order to accomplish the above object, a power control apparatus according to claim 1 of the present invention is a power control apparatus for a driving device to which power is supplied from a power supply device which is subject to current limitation at a predetermined current limit value, the power control apparatus comprising a rechargeable battery, and a charge control part for charging the battery when a current drain is lower than the limit current value, wherein current is supplied from said battery to the driving device when the current drain exceeds the limit current value.

[0010]

According to claim 2 of the present invention, in a power control apparatus according to Claim 1, the driving device is a device a current drain of which becomes transiently over the limit current value.

[0011]

According to claim 3 of the present invention, in a power control apparatus according to Claim 1 or 2, the power from the power supplying device is supplied via a USB connector.

[0012]

A USB equipment according to claim 4 of the present invention is a USB equipment comprising a driving device to which power is supplied from a power supply device which

is subject to current limitation at a predetermined current limit value, and a power control device connected to the power supply device via a USB connector and arranged to control power supply to the driving device, wherein the power control device comprises a rechargeable battery, and a charge control part for charging said battery when a current drain is lower than the limit current value and wherein current is supplied from the battery to the driving device when the current drain exceeds the limit current value.

[0013]

According to claim 5 of the present invention, in a power control apparatus according to Claim 4, the driving device is a device a current drain of which becomes transiently over the limit current value.

[0014]

According to claim 6 of the present invention, in a power control apparatus according to Claim 5, the driving device is comprised of a speaker device incorporating a power amplifier.

[0015]

According to claim 7 of the present invention, in a power control apparatus according to Claim 5, the driving device is comprised of a floppy disk drive.

[0016]

A power control method according to claim 8 of the present invention is a power control method for a driving device to which power is supplied from a power supplying

device which is subject to current limitation at a predetermined current limit value, the power control method comprising steps of preparing a rechargeable battery, charging the battery while a current drain is lower than the current limit value, and supplying a current from the battery to the driving device when the current drain exceeds the limit current value.

[0017]

According to claim 9 of the present invention, in a power control method according to Claim 8, the driving device is a device a current drain of which becomes transiently over the limit current value.

[0018]

[Detailed Description of the Preferred Embodiments]

The embodiments of the present invention will be described with reference to the drawings.

[0019]

First Embodiment

Fig. 1 is a block diagram to show the overall configuration of USB equipment according to the first embodiment of the present invention.

[0020]

The USB equipment of the present invention is configured as an amplifier-integrated loudspeaker device. This amplifier-integrated loudspeaker device receives a digital sound signal via a USB connector from a host computer such as a personal computer (PC), a workstation (WS), or

the like, converts this sound signal to an analog signal, further amplifies it, and reproduce the signal by loudspeakers.

[0021]

This amplifier-integrated loudspeaker device is composed of a power control block 10, a power block 20, a left channel speaker 104L, and a right channel speaker 104R.

[0022]

In the figure reference numeral 100 designates a USB connecter, to which USB signal line s101 and power line ps101 are assigned. In the power control block 10, reference numeral 101 denotes a USB controller, which sends and receives data to and from the host computer via USB signal line s101 and which separates voice data from the data to output it to digital voice signal line s102.

[0023]

Numeral 102 represents a D/A converter, which accepts input of the digital sound signal s102 and which outputs stereo audio analog signals of two left and right channels s103L, s103R.

[0024]

Symbols 103L, 103R are power amplifiers for audio, which receive the respective audio analog signals s103L, s103R and which amplify the signals to respective powers enough to drive the loudspeakers 104L and 104R described hereinafter and output the amplified signals to signal lines

s105L, s105R.

[0025]

Symbols 104L, 104R are loudspeakers, which receive the supply of power via power line ps105, which accept input of the electric sound signals through the signal lines s105L, s105R, and which convert the signals to air vibration to generate sound.

[0026]

Numeral 111 denotes a current limiter (1), which limits the power-supply current inputted through the power line ps101 from the USB connector 100. This is set at a value iL1 a little smaller than the maximum power-supply current 500 mA, which is the standard of USB.

[0027]

Numeral 112 designates a current detection part, which monitors the total current drain of this USB equipment, i.e., current i01 flowing through the power line psL02 and which controls current i02 so that the sum of the current i02 flowing in power line ps106 to battery charge control part 115 described below and device-operating current i03 for device operation except for battery charging is less than the above-stated set value of current limiter 111. This setting makes the charging current to the battery 116 smaller than a value obtained by subtracting the device-operating current i03 from the aforementioned set value iL1 of current limiter 111.

[0028]

Numeral 113 indicates a current limiter (2), which is set at such a value iL2 that the current input through the power line ps103 becomes less than a difference between the aforementioned set value iL1 of current limiter 111 and the maximum of current i03a to the power control block 10; whereby the current supplied to the power control block 10 can be assured by the current from the USB connector 100 even if the current i05 to the power block 20 detailed below becomes transiently large.

[0029]

Numeral 114 designates a power switching part, which supplies the current from power line ps104 and power line ps109 to the power block 20 through power line ps105. On this occasion, when the current i05 to the power block 20 is greater than the aforementioned set value iL2 of current limiter 113, control is made so that the insufficient current is supplied via the power line ps117 from the battery 116 and output voltage adjustment part 117. At this time, the sound will be heard as distorted if the current supply to the power block 20 is insufficient because of undercharge of the battery 116.

[0030]

Numeral 115 denotes a charge control part, which receives the current supply from the output ps106 of the current detection part 112 and which controls the charge to the battery 116 through the charge power line ps107. Here the battery 116 is a rechargeable, secondary battery,

which is charged through the charge power line ps107 and which supplies power through output line ps108.

[0031]

Numeral 117 represents an output voltage adjustment part, which adjusts the voltage of ps108 outputted from the battery 116 to a value a little smaller than the voltage of the aforementioned input power line ps102 and which outputs the adjusted voltage to the aforementioned power switching part 114 through the power line ps109.

[0032]

The change in the current drain i03a in the above power control block 10 is extremely smaller than that in the power amplifiers 103L, 103R, can be absorbed by a small-capacitance capacitor, so called a bus controller, and is substantially constant.

[0033]

On the other hand, the power block 20 is composed of the left and right power amplifiers 103L, 103R, in which the current drain i05 varies largely depending upon the voice input and can exceed 500 mA, which is the standard of USB.

[0034]

The action of the first embodiment will be described next referring to the flowchart of Fig. 2.

[0035]

When the equipment is activated, step S1 is first carried out to charge the battery 116 by the current within

(iL1 - i03). As described above, iL1 is the set value of current limiter 111 and i03 is the operating current value of the equipment. At this time, supposing that i03 becomes equal to iL1, the charge is interrupted and the maximum current supplied from the USB connector 100 is used for the action of the equipment.

[0036]

Then step S2 is to monitor whether i05 ≥ iL2. As described above, i05 is the current drain of the power block 20 and iL2 is the set value of current limiter 113. If i05 < iL2, the flow proceeds to step S3. Since the entire current can be supplied from the USB connector 100, the power switching part 114 supplies the current only from the power line ps104.

[0037]

At this time, there still remains a surplus of the supplied current from the USB connector 100 and this surplus is used for the charge of the battery 116 while being monitored in step S1.

[0038]

If there occurs an event of i05 ≥ iL2, the flow goes to step S4. Since the supplied current from the USB connector 100 is short by (i05 - iL5), the power switching part 114 supplies the current of the shortage from the battery 116 through the power line ps109.

[0039]

In the present embodiment, as described above, the

rechargeable battery 116 is mounted in the USB equipment, the battery 116 is charged when the normal power consumption is not more than the current limit value of USB, and the power is supplied from the battery 116 when the supplied current is transiently insufficient. This can realize the USB equipment that can operate only with the power supply from the USB connector 100, without degrading the performance of the equipment. Namely, the power supply of the equipment does not depend upon the supply from the other power supply than the USB interface bus, so that the USB equipment can be realized with capability of fully enjoying the convenience and simplicity of USB.

[0040]

Second Embodiment

Fig. 8 is a block diagram to show the overall configuration of USB equipment according to the second embodiment of the present invention.

[0041]

The USB equipment of the present embodiment is configured as a floppy disk drive. This floppy disk drive is an external memory device which sends and receives data via a USB connector from the host computer such as the personal computer (PC), the workstation (WS), or the like and which writes or reads the data in or from a floppy disk medium set in the device.

[0042]

This floppy disk drive has power control block 40

and power block 50 and also has head 405, head motor 406a, and spindle motor 406b.

[0043]

In the figure numeral 400 designates a USB connector, to which USB signal line s401 and power line ps401 are assigned. In the power control block 40, numeral 401 designates a USB controller, which sends or receives data to or from the host computer through USB signal line s401, which separates information necessary for a floppy disk controller (hereinafter referred to as an FDD controller), and read-write data of the floppy disk medium, and which outputs the data to signal line s402.

[0044]

Numeral 402 denotes an FDD controller, which accepts the input of signal from the signal line s402 and which executes output of control signals of various motors etc. necessary for control of the floppy disk, output of write data into the floppy medium, and input of read data via power source lines ps403a, ps403b, and ps403c.

[0045]

The FDD controller accepts input of information about battery 416 via information power line ps408 from charge control part 415 and also makes a judgment about whether the current supply to the power block 50 is insufficient because of undercharge of the battery 416.

[0046]

Numeral 403 represents a write/read (W/R) amplifier

for a floppy data head, which writes or reads data in or from the floppy disk medium via the power source lines ps403a and ps404a.

[0047]

Symbols 404a, 404b denote motor drivers for control of the floppy disk, which are controlled via signal lines s403a, s403b and which drive the head motor 406a and spindle motor 406b.

[0048]

Numeral 405 indicates a floppy data read/write head, which reads or writes data of the floppy disk via the R/W amplifier 403. Symbol 406a denotes a motor for movement of the read/write head 405, which is driven by the motor driver 404a to move the head 405 to a position necessary for reading/writing of the floppy medium.

[0049]

Symbol 406b represents a spindle motor for rotation of the floppy disk, which is driven by the motor driver 404b and which is used for rotating the floppy disk on the occasion of reading/writing of the floppy medium. Numeral 411 designates a current limiter (1), which limits the power-supply current supplied via the power line ps401 from the USB connector 400. This is set at a value iL41 a little smaller than the maximum power-supply current 500 mA, which is the standard of USB.

[0050]

Numeral 412 indicates a current detection part,

which monitors the whole current drain of the equipment in the present embodiment, i.e., current i41 flowing in power line ps402 and which controls current i42 so that the sum of the current i42 flowing in power line ps406 to charge control part 415 and device-operating current i43 for operation of the equipment except for charging of battery 416 is less than the set value of the current limiter 411. This makes the charge current to the battery 416 smaller than a value obtained by subtracting the device-operating current i43 from the set value iL41 of the current limiter 411.

[0051]

Numeral 413 is a current limiter (2), which is set at such a value iL42 that the current input from the power line ps403 is less than a difference between the set value iL41 of current limiter 411 and the maximum of current i43a to the power control block 40; whereby the current to the power control block 40 can be assured by the current from the USB connector 400 even if the current i45 of the power block 50 described below becomes transiently large upon activation of the motor.

[0052]

Numeral 414 denotes a power switching part, which supplies the current from power line ps404 and power line ps410 to the power block 20 via power line ps405.

[0053]

On this occasion, when the current i45 to the power

block 50 exceeds the set value iL42 of the current limiter 413, control is made so that the current of the shortage is supplied via the power line ps410 from the battery 416 and output voltage adjustment part 410.

[0054]

Numeral 415 stands for a charge control part, which receives the current supply from the output ps406 of the current detection part, which controls the charge to battery 416 via charge power line ps407, and which monitors the remainder of the battery 416 to output the information via the information power line ps408. Here the battery 416 is a rechargeable, secondary battery, which is charged via the charge line ps407 and which supplies power via output line ps408.

[0055]

Numeral 417 denotes an output voltage adjustment part, which adjusts the voltage of output ps409 from the battery 416 to a value a little smaller than the voltage of the input power line ps402 and which outputs the adjusted voltage via power line ps410 to the power switching part 414.

[0056]

The change of the current drain i43a in the above power control block 40 is extremely smaller than that in the R/W amplifier 403 and various motors 404a, 404b, can be absorbed by a small-capacitance capacitor which is a so-called a bus capacitor, and is substantially constant.

[0057]

On the other hand, the power block 50 is composed of the R/W amplifier 403 and various motors 404a, 404b, in which the current drain i45 varies large, depending upon activation of the floppy disk, the seek operation of the head, etc. and can exceed 500 mA which is the standard of USB.

[0058]

The action of the second embodiment will be described next referring to Fig. 4.

[0059]

When the equipment is activated, step S11 is first carried out to charge the battery 416 by the current within (iL41 - i43). As described above, iL41 is the set value of current limiter 411 and i43 is the operating current value of the equipment. At this time, supposing i43 becomes equal to iL41, the charging is interrupted and the maximum current supplied from the USB connector 400 is used for the action of the equipment.

[0060]

Then step S12 is to monitor whether $i45 \geq iL43$. As described, i45 is the current drain of the power block 50 and iL43 is the set value of current limiter 413.

[0061]

If $i45 < iL43$, the flow proceeds to step S14. Since the whole current can be supplied from the USB connector 400, the power switching part 414 supplies the current only

from the power line ps404. At this time, there still remains a surplus of the supplied current from the USB connector 400, so that this is monitored in step S11 to be used for charging of the battery 416.

[0062]

When an event of $i45 \geq iL42$ occurs, the supplied current from the USB connector 400 becomes short by (i45 - iL42). In this case, the flow proceeds to step S13, in which the FDD controller 402 determines whether the battery 416 can afford the power to the various motors 406a, 406b for driving of the floppy disk and the power for driving of the R/W amplifier 403 of the head 405.

[0063]

When it is determined that the battery 416 has sufficient power, the flow proceeds to step S15, in which the FDD controller 402 drives the various motors 406a, 406b for driving of the floppy disk and the R/W amplifier 403 of the head 405. On this occasion the power switching part 414 supplies the current of the shortage from the battery 416 via the power line ps410.

[0064]

When it is determined that the battery 416 cannot afford the power, the flow proceeds to step S16, in which the FDD controller 402 determines that an anomaly occurs in the device, halts the action of the floppy disk, transfers the information to the host computer, and awaits instructions.

[0065]

The present embodiment can also accomplish the effect equivalent to that of the above first embodiment. Namely, the equipment of the present embodiment is so configured that the rechargeable battery is mounted in the main body, that the battery is charged while the power consumption of the equipment is lower than the supplied power, and that the charged battery supplements the transient shortage power of the equipment; whereby the present embodiment can provide the USB equipment that can be operated by only the power supply from the USB connector, without degrading the performance of the equipment.

[0066]

[Effect of the Invention]

As specifically described above, according to the power control apparatus of claims 1 to 3 of the present invention, the USB equipment of claims 4 to 7 of the present invention, and the power control method of claims 8 or 9 of the present invention, it is rendered possible to assure the convenience and simplicity of USB without degrading the performance of the equipment. That is, it is rendered possible to realize the USB equipment that can operate only with the power supply from the USB connector, without depending upon the supply from the other power supply than the USB interface bus.

[Brief Description of the Drawings]

[Figure 1]

A block diagram to show an overall configuration of USB equipment according to the first embodiment of the present invention.

[Figure 2]

A flowchart to show the operation of the first embodiment.

[Figure 3]

A block diagram to show an overall configuration of USB equipment according to the second embodiment of the present invention.

[Figure 4]

A flowchart to show the operation of the second embodiment.

[Description of Reference Numerals or Symbols]

10, 40 … power control blocks

20, 50 … power blocks

100, 400 … USB connectors

101, 401 … USB controllers

102, 402 … D/A converters

103L, 103R … power amplifiers for audio

104L, 104R … loudspeakers

111, 411 … current limiters (1)

112, 412 … current detection parts

113, 413 … current limiters (2)

114, 414 … power switching parts

115, 415 … battery charge control parts

116, 416 … batteries

117, 417 … output voltage adjustment parts

[Name of the Document] Abstract

[Abstract]

[Object]

An object of the present invention is to provide a power control apparatus of USB equipment that can assure the convenience and simplicity of USB without degrading the performance of USB equipment.

[Means for Achieving the Object]

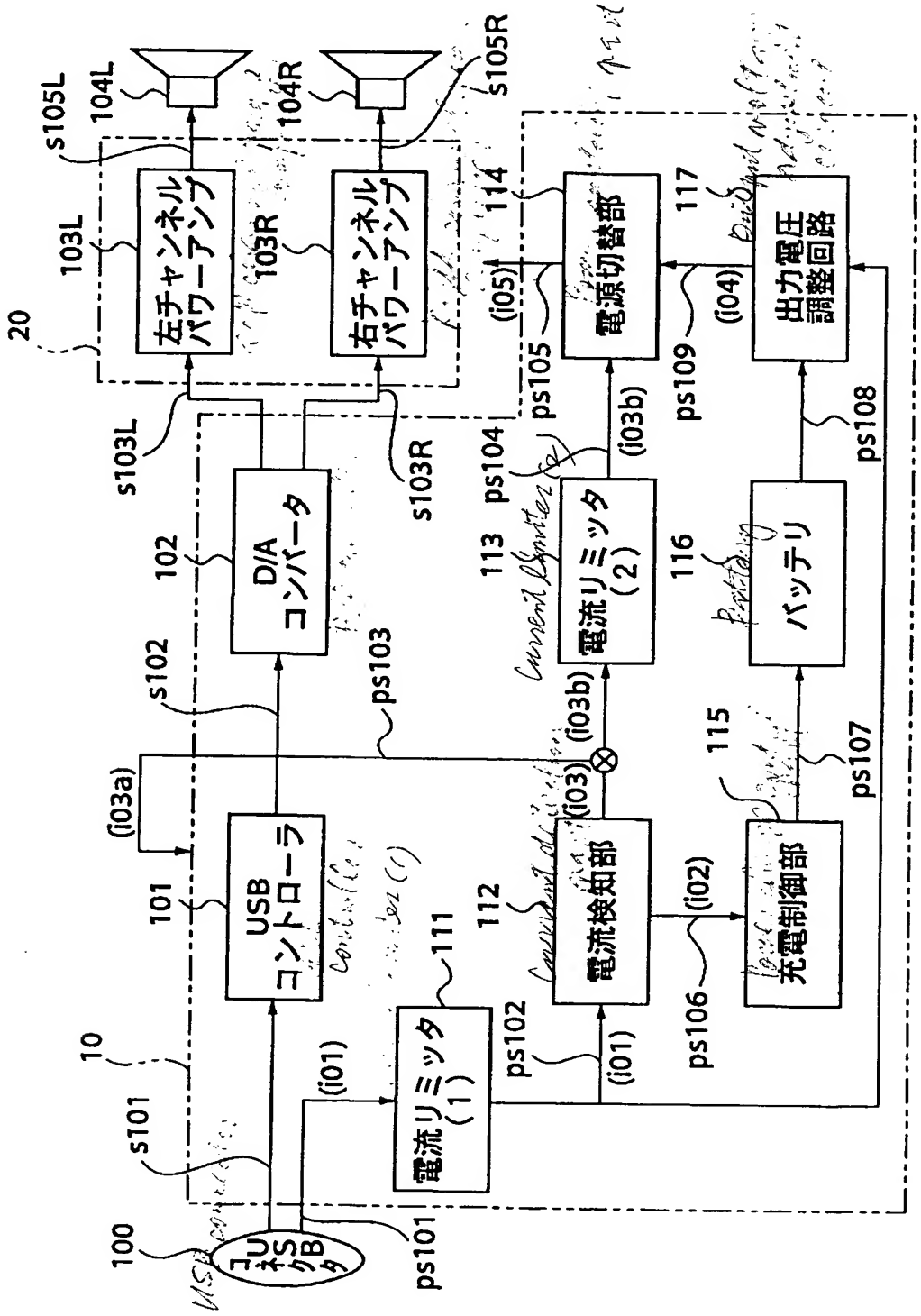
The power control apparatus comprises a rechargeable battery 116, and the battery 116 is charged when the normal power consumption is not more than the current limit value of USB, and the power is supplied from the battery 116 to a power block part 50 when the power consumption of the power block part 50 transiently exceeds the limit current value, that is, when the supplied current is transiently insufficient.

[Elected Drawing]

Figure 1

【書類名】　図面

【図１】


20
103L
左チャンネル パワーアンプ
104L
s105L
103R
右チャンネル パワーアンプ
104R
s105R
s103L
s103R
102
D/A コンバータ
s102
ps103
(i03a)
101
USB コントローラ
10
s101
(i01)
電流リミッタ (1)
111
ps102
100
USB コネクタ
ps101
112
電流検知部
(i03)
(i02)
ps106
(i01)
115
充電制御部
ps107
(i03b)
113
電流リミッタ (2)
ps104
(i03b)
116
バッテリ
ps108
(i05)
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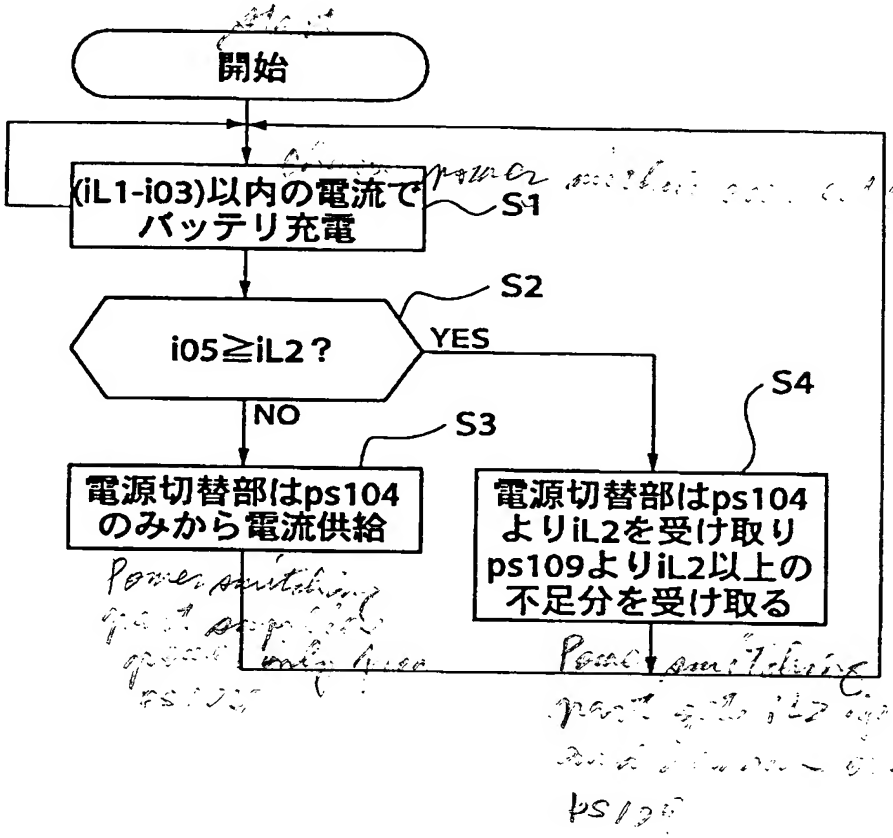
ps105
117
出力電圧 調整回路
(i04)
ps109

【図２】


開始
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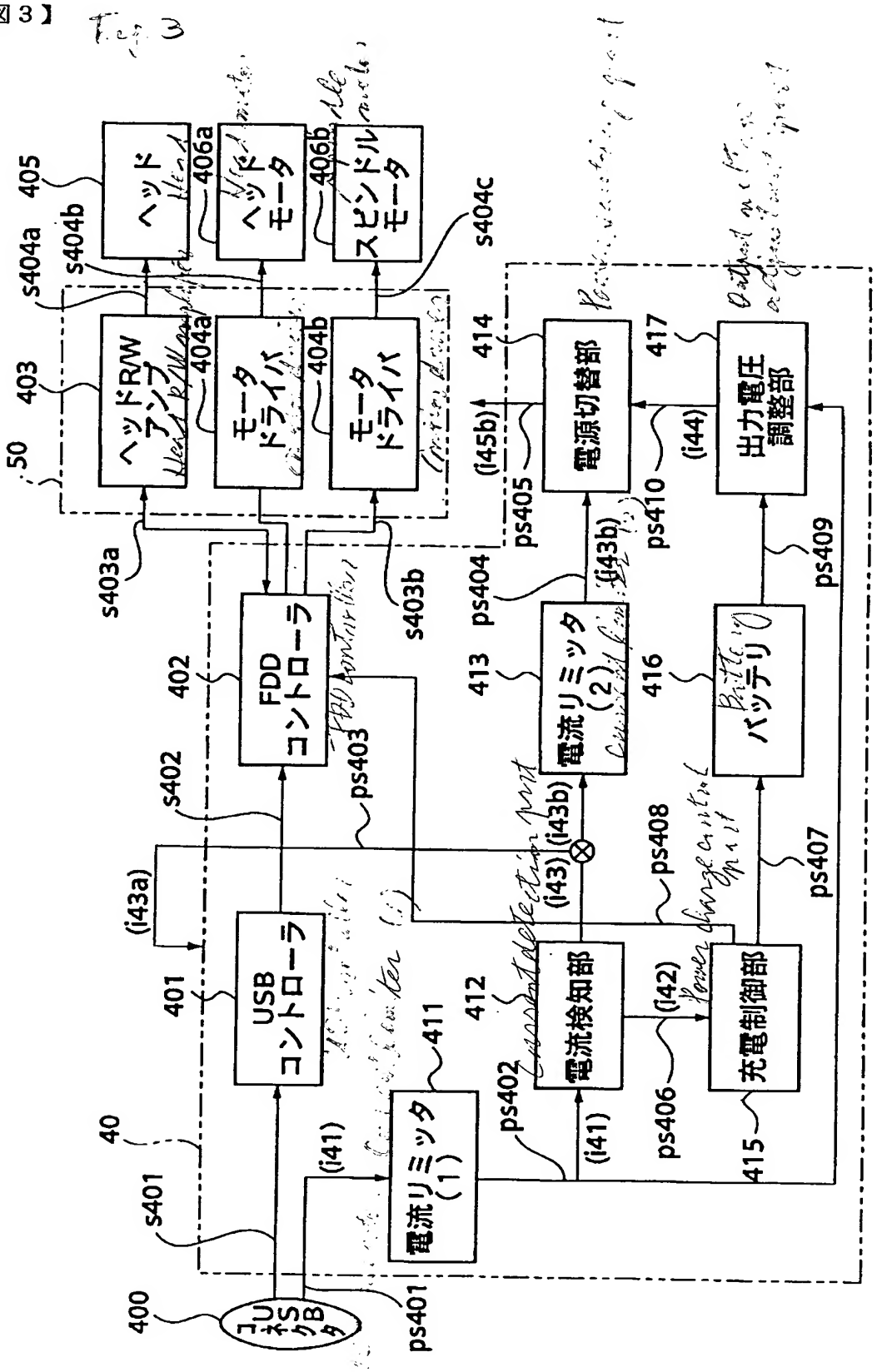
S1
S2
i05≧iL2？
YES
NO
S3
S4
電源切替部はps104のみから電流供給
電源切替部はps104よりiL2を受け取りps109よりiL2以上の不足分を受け取る

【図３】


ヘッド
ヘッドモータ
スピンドルモータ
ヘッドRWアンプ
モータドライバ
モータドライバ
FDDコントローラ
USBコントローラ
電流リミッタ(1)
電流リミッタ(2)
電流検知部
充電制御部
電源切替部
出力電圧調整部
バッテリ
USBケーブル
405
406a
406b
404a
404b
404c
403
50
414
417
402
413
416
401
412
411
40
400
s404a
s404b
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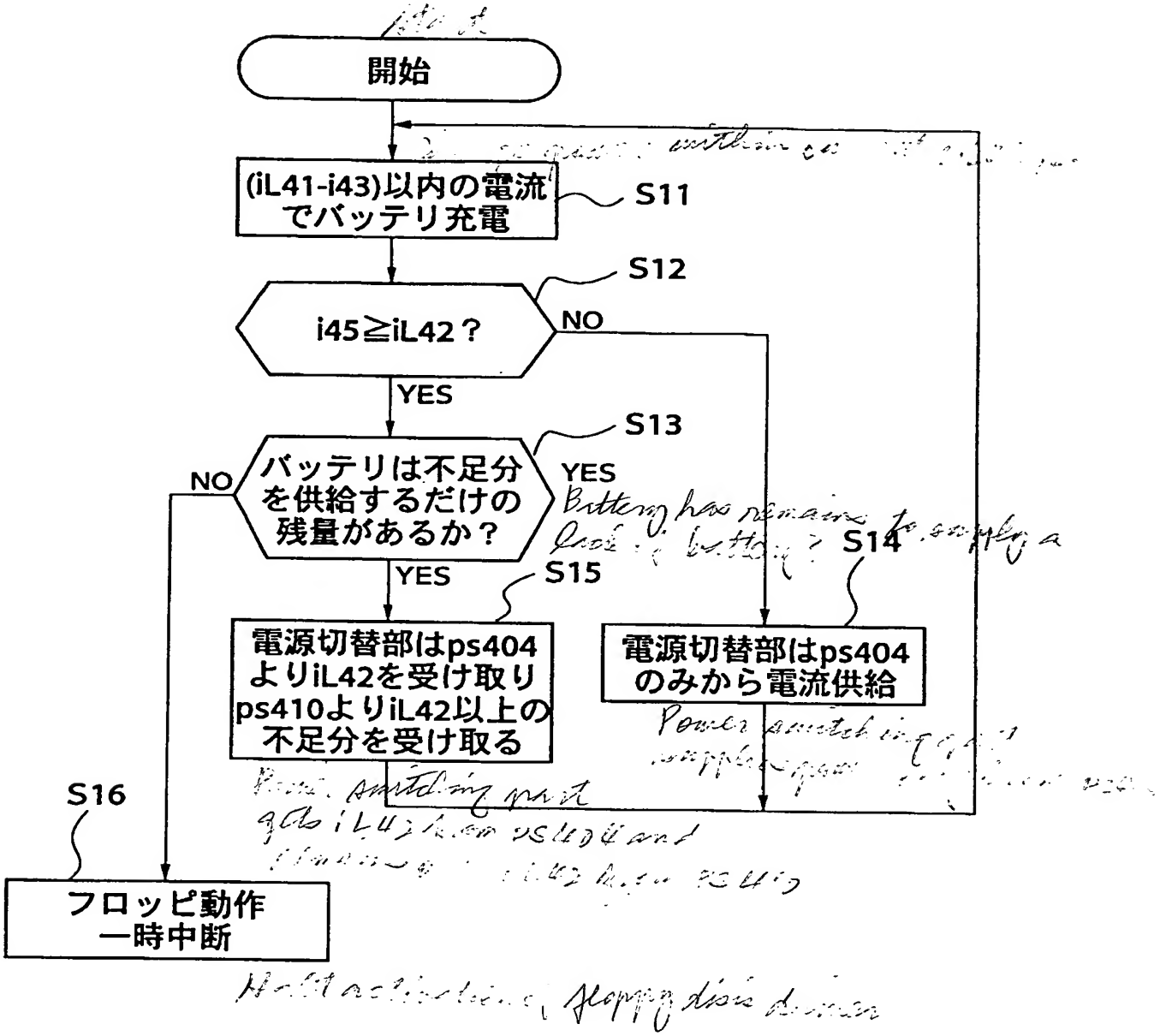
(i45b)
415

【図４】


開始
(iL41-i43)以内の電流でバッテリ充電
S11
S12
i45≧iL42？
NO
YES
S13
バッテリは不足分を供給するだけの残量があるか？
YES
NO
S14
S15
電源切替部はps404よりiL42を受け取りps410よりiL42以上の不足分を受け取る
電源切替部はps404のみから電流供給
S16
フロッピ動作一時中断